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TURA Priority Industry Sector Identification

Economic and Environmental Ranking of Massachusetts' Economic Sectors

Methods and Policy Report No. 17 **July 1998**

University of Massachusetts Lowell

TURA Priority Industry Sector Identification

Economic and Environmental Ranking of Massachusetts' Economic Sectors

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OVERVIEW OF THIS REPORT

The Toxics Use Reduction Institute (TURI) has contracted with Tellus Institute to assist the TURA Advisory Board and Program Agencies to set priorities for the next phase of development of the Toxics Use Reduction Act (TURA) program.

This report is intended as background for TURA to help identify those sectors of the Massachusetts economy which might be best served by the TURA program in the future. In consultation with TURI, Tellus implemented a two-stage screening process. The first screening is an economic screening intended to identify those sectors of the Massachusetts economy that are likely to be important contributors to the state's development in the short term.

The second stage is an environmental screening to rank the selected economic sectors by their potential for environmental impact, their level of untapped opportunity for environmental improvement, and their potential to benefit from TURA services.

The final step in this report is to combine the environmental and economic ranking data to develop a short list of economic sectors for TURA to focus on in its strategic planning activities.

This analysis is limited to those sectors of the economy within SIC categories covered by TURA but includes both Large Quantity Toxics Users (LQTUs) and non-LQTUs (data permitting).

SUMMARY OF FINDINGS

Tellus ranked sectors of the Massachusetts economy at the 3 digit Standard Industrial Classification (SIC) code level on both their economic importance and their environmental significance. These rankings were based on a number of indicators:

Economic Indicators

- Number of Establishments
- Size of Payroll
- Number of Employees
- Change in Number of Employees

Environmental Indicators

- RCRA Reporting Data
- Clean Air Act Data
- NPDES Discharges
- Industrial Loadings to POTWs
- Estimated Energy Demand
- Estimated Water Use
- TURA Use Data
- TURA "Modified" TRI (TRI + CERCLA Chemicals)
- TURA "Generated as Byproduct" Data

The two tables below present those sectors that rank highest on both the economic and environmental indicators. Exhibit 1 presents the highest ranking sectors; Exhibit 2 presents the next tier of high ranking sectors. These "Second Tier" sectors rank less high on the economic indicators, but high on the environmental indicators. Sectors in **bold text** rank especially high on the environmental indicators. These exhibits are intended to guide TURA in identifying industry sectors to focus on in its strategic planning activities.

Exhibit 1: Sectors of the Massachusetts Economy Ranking Highest on Both the Economic and Environmental Indicators (First Tier)

3 Digit SIC	Description
367	**Electronic components and accessories**
308	**Miscellaneous plastics products, n.e.c.**
382	Measuring and controlling devices
275	**Commercial printing**
344	Fabricated structural metal products
355	Special industry machinery
721	**Laundry, cleaning, & garment services**
356	General industrial machinery
283	Drugs

Exhibit 2: Sectors of the Massachusetts Economy Ranking High on Both the Economic and Environmental Indicators (Second Tier)

3 Digit SIC	Description	3 Digit SIC	Description
384	Medical instruments and supplies	399	Miscellaneous manufactures
335	**Nonferrous rolling and drawing**	357	Computer and office equipment
347	**Metal services, n.e.c.**	265	Paperboard containers and boxes
495	**Sanitary services**	**289**	**Miscellaneous chemical products**
516	Chemicals and allied products	**342**	**Cutlery, hand tools, and hardware**
364	Electric lighting and wiring equipment	517	Petroleum and petroleum products
209	Misc. food and kindred products	**267**	**Misc. converted paper products**

The remainder of this report describes the economic and environmental ranking in detail.

SUMMARY OF ECONOMIC RANKING

The top ten ranking sectors of the Massachusetts economy at both the 3-digit and 2-digit SIC level are presented in the Exhibit 3 and Exhibit 4. In each table we have developed two rankings: one that excludes from the count those 4-digit SIC sectors with an average of fewer than 10 employees per firm, and one that includes those sectors in the count. This information is pertinent because TURA excludes those firms with fewer than 10 employees. The major differences between the two lists are highlighted.

Note that the top seven or nine 3-digit sectors are either business services (SIC 73X) or wholesale trade (SIC 50X-51X); manufacturing (SIC 20X-39X) does not appear until number eight or ten. Expanded lists appears later in this memo, should TURI desire a wider range of sectors as candidates to target in the future.

It is important to remember that these rankings do not take into account the use or production of toxic materials. That information is incorporated in the environmental screening phase of our analysis, discussed later in this report.

Exhibit 3: Top Ten Ranking TURA Eligible Sectors of the Massachusetts Economy - 3 Digit SIC Level

Excluding **Sectors w/ Under 10 Employees**			***Including*** **Sectors w/ Under 10 Employees**		
Rank	**SIC**	**Description**	**Rank**	**SIC**	**Description**
1	737	Computer and data processing services	1	737	Computer and data processing services
2	736	Personnel supply services	2	736	Personnel supply services
3	504	Professional & commercial equipment	3	504	Professional & commercial equipment
4	506	Electrical goods	4	506	Electrical goods
5	738	Miscellaneous business services	5	738	Miscellaneous business services
6	514	Groceries and related products	6	734	Services to buildings
7	734	Services to buildings	7	514	Groceries and related products
8	367	Electronic components and accessories	**8**	**508**	**Machinery, equipment, and supplies**
9	*308*	*Miscellaneous plastics products, n.e.c.*	**9**	**753**	**Automotive repair shops**
10	*382*	*Measuring and controlling devices*	10	367	Electronic components and accessories

Exhibit 4: Top Ten Ranking TURA Eligible Sectors of the Massachusetts Economy - 2 Digit SIC Level

Excluding **Sectors w/ 9 or Fewer Employees**			***Including*** **Sectors w/ 9 or Fewer Employees**		
Rank	**SIC**	**Description**	**Rank**	**SIC**	**Description**
1	73	Business services	1	73	Business services
2	50	Wholesale trade-durable goods	2	50	Wholesale trade-durable goods
3	51	Wholesale trade-nondurable goods	3	51	Wholesale trade-nondurable goods
4	36	Electric and electronic equipment	4	36	Electric and electronic equipment
5	27	Printing and publishing	5	27	Printing and publishing
6	34	Fabricated metal products	**6**	**75**	**Auto repair, services, and garages**
7	48	Communication	7	34	Fabricated metal products
8	30	Rubber and misc. plastics products	8	48	Communication
9	35	Industrial machinery and equipment	9	35	Industrial machinery and equipment
10	*20*	*Food and kindred products*	10	30	Rubber and misc. plastics products

SOURCES OF INFORMATION ON THE MASSACHUSETTS ECONOMY

There is a large amount of historical information available on the Massachusetts economy, as well as limited economic forecasts. The historical information is available at the 3 and 4 digit SIC level, whereas projections are available at the 2 digit SIC level. Together, this information contains several indicators by which the various sectors of the economy may be ranked in terms of current and anticipated economic performance.

In this report we focus on rankings at the 3 digit SIC level based on: 1) number of firms (1996), 2) size of payroll (1996), 3) number of employees (1996), and 4) absolute increase in number of employees (1993 to 1996). We then combine these rankings into an overall ranking. Finally, we compare these rankings to a projection of growth in average gross state product at the 2 digit SIC level.

We have limited the analysis to those sectors of the economy within the SIC categories covered by TURA (10-14, 20-39, 40, 44-51, 72-73, and 75-76).

Our primary sources for this analysis are the following:[1]

- State of Massachusetts Employment and Wages (ES-202) information for 1993, 1995, and the fourth quarter of 1996.
- A list of all TURA filers to date. This was provided Tellus as an Excel spreadsheet by Elizabeth Harriman of TURI.
- The *Economic Census 1992 for State of Massachusetts*.
- Bureau Of The Census, *Annual Survey Of Manufactures*, Table 2. Statistics for the United States and States by Industry Group: 1995 and 1994.
- Regional Economic Analysis Division, Bureau of Economic Analysis, United States Department of Commerce. *Data From BEA Regional Projections To 2045: Volume 1, States*. Published July, 1995.

We also contacted the Executive Office of Environmental Affairs, the Executive Office of Economic Affairs, and the Massachusetts Institute for Social and Economic Research (MISER), who confirmed that we had found the most appropriate sources of information on the Massachusetts economy.

We have also been in regular communication with the Massachusetts Department of Revenue (since October 1997) in an effort to receive information on business revenues. They have been very slow in releasing this information. As a result, we have not been able to incorporate it in this report.

In all cases, the SIC data was used as reported.

These diverse sources of information provide a range of data on the Massachusetts economy including, but not limited to, those shown in Exhibit 5.

[1] Much of this information is available on the Internet. See Appendix C for details.

Exhibit 5: Key Information Available on the Massachusetts Economy

Source of Information	Type of Information Available: Level of Detail	Number of Employees	Dollar Value of Payroll	Number of Establishments	Other Information
State of Massachusetts Employment and Wages (ES-202) Information — 1996	3 digit SIC	X	X	X	Average Wage Paid
1992 Economic Census	4 Digit SIC	X	X	X	Value of Shipments or Receipts
Annual Survey Of Manufactures — 1995	3 digit SIC (SICs 201-399 only)	X	X		Number of Production workers Hours Worked Wages Earned Value added by Manufacture Cost of Materials New Capital Expenditures End-of-year Inventories
1995 BEA Projections (1998 through 2045)	2 digit SIC (not all SICs)	X			Earnings Gross State Product
List Of All TURA Filers	4 Digit SIC				

METHODOLOGY FOR ECONOMIC RANKING

We conducted a wide range of analysis using the information outlined above. A series of tables in Appendix A and B presents these analyses. From this abundance of information, we focused on ranking Massachusetts industries at the 3 Digit SIC level on each of the following key indicators:

- Number of Firms
- Size of Payroll
- Number of Employees
- Increase in Number of Employees 1993 to 1996

We selected these as our primary indicators because 1) they are available in the most recent data sets, 2) they are available at the 3 digit SIC level, and 3) they are reasonable indicators of economic importance.

Exhibit 6 summarizes the ranking of industries by these key indicators at the 3 digit SIC level incorporating information from the 4-digit sectors averaging nine or fewer employees per firm. Details behind the economic indicators are provided in Appendix A, as well as an exhibit showing the top 25 3-digit sectors *excluding* information from the 4-digit sectors averaging nine or fewer employees per firm. Those sectors identified in Exhibit 6 with **bold text** would not rank in the top 25 sectors if information from the 4-digit sectors averaging nine or fewer employees per firm were excluded.

Note that only seven of the top 25 sectors are Manufacturers (SIC 20-39). Nine are Wholesale Trade (SIC 50-51) and five are Business Services (SIC 73).

Exhibit 6: Top 25 Ranking Massachusetts TURA Industries by Key Economic Indicators
3 Digit SIC Level
***Including* 4 Digit SIC Level Sectors Averaging 9 or Fewer Employees per Firm**

Industry Identification		Rank by Economic Indicator					
3 Digit SIC	Description	Number of Firms	Size of Payroll	Number of Employees	Increase in Number of Employees	Average of Ranks	Percent of Firms TURA Filers
737	Computer and data processing services	1	1	2	2	2	0.00
736	Personnel supply services	11	4	1	1	4	0.00
504	Professional & commercial equipment	3	2	3	16	6	0.00
506	Electrical goods	6	6	11	4	7	0.00
738	Miscellaneous business services	4	13	4	7	7	0.04
734	Services to buildings	9	26	5	5	11	0.00
514	Groceries and related products	8	9	9	21	12	0.00
508	**Machinery, equipment, and supplies**	**7**	**15**	**20**	**15**	**14**	**0.00**
753	**Automotive repair shops**	**2**	**29**	**17**	**12**	**15**	**0.00**
367	Electronic components and accessories	40	5	6	11	16	23.08
733	Mailing, reproduction, stenographic	14	22	25	6	17	0.00
308	Miscellaneous plastics products, n.e.c.	34	11	12	17	19	13.51
519	Misc. nondurable goods	13	27	21	13	19	0.10
382	Measuring and controlling devices	42	7	8	18	19	6.58
451	Air transportation, scheduled	51	14	10	3	20	2.09
359	Industrial machinery, n.e.c.	19	25	29	10	21	0.13
275	Commercial printing	18	17	14	52	25	0.96
501	Motor vehicles & automotive equipment	15	30	28	30	26	0.00
723	**Beauty shops**	**5**	**61**	**19**	**19**	**26**	**0.00**
472	**Arrangement of transportation**	**12**	**44**	**33**	**31**	**30**	**0.00**
344	Fabricated structural metal products	37	38	34	23	33	1.60
509	**Miscellaneous durable goods**	**16**	**45**	**43**	**29**	**33**	**0.00**
512	Drugs, proprietaries, and sundries	39	32	44	20	34	0.00
355	Special industry machinery	54	24	30	33	35	6.02
503	**Lumber and construction materials**	**21**	**42**	**44**	**37**	**36**	**0.00**

This applicability of these rankings to the short term future of the Massachusetts economy is supported by the Bureau of Economic Analysis *BEA Regional Projections to 2045* at the 2 digit SIC level shown in Exhibit 7 below. Sixteen of the top twenty-five industries in the 3-digit sectors in the above exhibits are included in the 2-digit SICs with highest projected growth in Gross State Product.

Exhibit 7: Top TURA Industries 2 Digit SICs by Projected Absolute Growth in Gross State Product 2000-2010*

Rank	SIC	Description	Projected Absolute Growth in Gross State Product (Millions of 1987 $)
1	50, 51	Wholesale trade	$2,654
2	73, 76	Business and miscellaneous repair services	$1,898
3	48	Communications	$1,145
4	35	Industrial machinery and equipment	$1,118

*Gross State Product (GSP) is the State-level counterpart to the Gross Domestic Product (GDP). It is measured as the sum of Gross State Product Originating (GSPO) in all industries in the state. Each industry's GSPO (value added) is equivalent to its gross output, or what is taken in minus what is expended.

ENVIRONMENTAL RANKING

The second phase of the TURA strategic planning exercise is to provide an environmental screening of Massachusetts industry to complement the economic screening. This section of the report summarizes that effort.

Organization

We first discuss the results of our data gathering efforts. The sources of data investigated are listed below. These are described in detail in the next section of the report.

- **RCRA Hazardous Waste Generation:** From US EPA's Biennial Reporting System
- **Clean Air Act Emissions:** From Massachusetts DEP permits database
- **Clean Water Act Water Discharges:** From EPA's NPDES database
- **Industrial Loadings to POTWs:** From the Massachusetts Water Resources Authority (MWRA)
- **Energy Use:** From the Massachusetts Division of Energy Resources
- **Water Use:** From the MWRA
- **Toxics Use Reduction Act Data:** From Massachusetts DEP
- **Solid Waste Generation and Recycling:** From Massachusetts DEP

Following this, we discuss and present rankings developed using each of these sources of data.

SOURCES OF DATA FOR THE ENVIRONMENTAL RANKING

We have gathered data from a number of sources, including the following:

- **RCRA Hazardous Waste Generation:** We received on diskette the 1995 annual total generation of RCRA hazardous solid waste for each Massachusetts large quantity generator by 4 digit SIC code. This information was provided via the EPA Region 1 RCRA Biennial Report System by MA DEP Bureau of Waste Prevention (Beth McDonough).
- **Clean Air Act Emissions:** Annual air emission totals for PM10, SO_2, NO_X, CO, and VOC are recorded in the MA DEP SSEIS database for all permitted facilities. Included with facility data is the 4 digit SIC code. We received this information for calendar year 1996.
- **Clean Water Act Water Discharges:** Annualized direct surface water discharge quantities for all pollutants are recorded in the EPA Region 1 National Pollution Discharge Elimination Systems (NPDES) database for all permitted facilities from NPDES permits. Included with facility data is the 4 digit SIC code. Ed Kim, of EPA Region 1, developed a report for us. Mr. Kim expressed most confidence in the quality of data for those dischargers classified as "major dischargers". This classification covers those dischargers judged by the State to have the greatest potential impact on water bodies. It is a small subset of all dischargers. We received from Mr. Kim the total annual loading by industry sector, at the 4 digit SIC level for calendar year 1996.

- **Industrial Loadings to POTWs:** We received from the Massachusetts Water Resources Authority (MWRA) information on discharges by industry to POTWs for the period October 1996 to October 1997. Included with facility data is the 4 digit SIC code.
- **Energy Use:** John Murphy, MA Division of Energy Resources, provided us with 1995 estimated total energy demand by Massachusetts industry at the 2-digit SIC code level. These estimates were downloaded from the State's 2020 energy model.
- **Water Use:** We received from the Massachusetts Water Resources Authority a study estimating nonresidential water use coefficients at the 2 digit SIC code level.[2]
- **Toxics Use Reduction Act Data:** We downloaded from the web the complete 1995 TURA data.[3] The reporting firms are limited to those that fall within the following constraints:
    - Ten or more employees, and
    - Manufactures or processes over 25,000 pounds of the TURA-regulated chemicals or uses more then 10,000 pounds of any one designated chemical, and
    - Is covered by SIC code categories 10-14, 20-40, 44-51, 72-73, and 75-76.

    We have developed rankings from this data. The methodology and results are discussed below.
- **Solid Waste Generation and Recycling:** Roy F. Weston Consulting prepared a report in 1996 for the Massachusetts DEP that initially appeared to be relevant. We spoke with Phil Weinberg of the DEP's Commissioner's Office regarding this report. According to Mr. Weinberg, the report focused on estimating the amount of material recycled per employee in some broad industry sectors. Earlier attempts by DEP to estimate SW generation by different industry sectors were in MA had not been successful. Currently, the state estimates generation of the commercial sector as a whole by subtracting known residential generation from known amount of waste disposed (adjusting for imports).

    Available reports that quantify solid waste generation for non-residential generators aggregate at a very high level (e.g., all manufacturing is assigned to either durable or non-durable manufacturing), and thus was felt that it would not support a useful analysis.

As with the economic information, the SIC data was used as reported.

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[2] Planning and Management Consultants, Ltd., Carbondale, Illinois. "Application of the IWR-Main Water use Forecasting System, Version 6.0: Selected Study Areas in the Massachusetts Water Resources Authority Service Area," Final Draft, November 22, 1993. Table IV-6: Selected Non-Residential Water Use Coefficients (GED). Coefficient with Price/Efficiency Adjustments (4th/rightmost column).

[3] http://www.magnet.state.ma.us/dep/bwp/dhm/tura/turapubs.htm#data

ENVIRONMENTAL RANKING RESULTS BASED ON COLLECTED DATA

Results From RCRA Data

The biennial reporting system (BRS) provides information on hazardous waste activities associated with generators and treatment, storage, and disposal facilities throughout the U.S. The information is collected every other year, and was most recently collected for 1995. We analyzed the information for the generators and facilities located in the State of Massachusetts. This information was provided by Beth McDonough of the Massachusetts DEP. We have also received, but have not analyzed, data for 1993.

The BRS data is of *limited utility* for conducting an environmentally based ranking of Massachusetts' industries.

- Waste is reported using EPA hazardous waste codes. Some of these codes are broad (e.g., D001—ignitable waste) or do not provide enough information to understand the specific nature of the waste (e.g., F012—quenching wastewater treatment sludges from metal heat treating operations in which cyanides are used in the process). Thus, in some cases it is difficult to learn from the BRS data the exact amount and type of hazardous material generated.
- A particular reported waste may fall under multiple waste codes. In some cases, this indicates a mixture of wastes, further complicating analysis. In the 1995 BRS, 6,782 different wastes were reported using over 21,000 different codes – an average of over three waste codes per waste.

Given these limits, we were unable to carry out a sophisticated analysis, and were limited to ranking industries by gross generation. To do this, we first converted totals of waste generated on site to a common metric (kilograms). This required applying reported densities and standard conversion factors to wastes reported.[4] The kilograms were then summed by industry at the 3-Digit SIC code, and ranked by total on site generation. The results of this ranking are presented in Exhibit 8.

It is important to keep in mind that this ranking is based on mass of undifferentiated RCRA regulated waste generated: it does not take into account the differing degrees of hazard presented by different wastes.

[4] The reporting form permits seven units of measure: Pounds, short tons, kilograms, metric tonnes, gallons, liters, cubic yards. Density, where required, is reported as either pounds per gallon or specific gravity.

Exhibit 8: Top 25 Massachusetts Industry Sectors (3-Digit SIC Level) Ranked by Kilograms of Undifferentiated RCRA Regulated Waste Generated On Site 1995 Biennial Reporting System – Massachusetts Data

3 Digit SIC	Description	Kilograms
367	Electronic components and accessories	1,087,621,126
347	Metal services, n.e.c.	398,055,138
493	Combination utility services	273,905,518
386	Photographic equipment and supplies	253,796,904
349	Misc. fabricated metal products	248,860,356
348	Ordnance and accessories, n.e.c.	206,445,359
357	Computer and office equipment	104,735,752
346	Metal forgings and stampings	87,271,641
372	Aircraft and parts	28,681,273
366	Communication equipment	23,386,084
391	Jewelry, silverware, and plated ware	22,573,317
342	Cutlery, hand tools, and hardware	13,319,401
331	Blast furnace and basic steel products	13,141,537
335	Nonferrous rolling and drawing	10,723,152
376	Guided missiles, space vehicles, parts	9,909,641
361	Electric distributing equipment	7,325,189
382	Measuring and controlling devices	6,688,145
282	Plastics materials and synthetics	4,699,500
286	Industrial organic chemicals	4,565,862
399	Miscellaneous manufactures	4,507,436
517	Petroleum and petroleum products	3,396,768
267	Misc. converted paper products	3,394,246
305	Hose & belting & gaskets & packing	2,829,713
289	Miscellaneous chemical products	2,617,829
275	Commercial printing	2,181,630

Results from Clean Air Act Data

As noted above, we received from MA DEP annual air emission totals for volatile organic compounds (VOCs) and the criteria air pollutants (CAPs) PM10, SO_2, NO_X, and CO for all permitted facilities in the state. We understand that this information represents monitored emissions for calendar year 1996. Included with the facility data is the 4 digit SIC code.

Exhibit 9 shows the top 25 ranking sectors in reported emissions of VOCs. Note that this information was provided as emissions of undifferentiated VOCs. No attempt has been made to incorporate the varying hazard of emitted VOCs.

Exhibit 10 shows the top 25 ranking sectors in criteria air pollutants. This ranking is an unweighted composite of the rankings on the four reported CAPs. Again, no attempt has been made to incorporate the varying hazard of emitted CAPs.

Exhibit 9: Top 25 Emitters of Volatile Organic Compounds
Massachusetts Industry Sectors (3-Digit SIC Level)—1996

3 Digit SIC	Description	VOC Emissions (tons/yr)	Rank
308	Miscellaneous plastics products, n.e.c.	940	1
229	Miscellaneous textile goods	887	2
267	Misc. converted paper products	707	3
275	Commercial printing	667	4
517	Petroleum and petroleum products	620	5
306	Fabricated rubber products, n.e.c.	510	6
491	Electric services	499	7
347	Metal services, n.e.c.	478	8
495	Sanitary services	447	9
367	Electronic components and accessories	407	10
251	Household furniture	362	11
311	Leather tanning and finishing	359	12
226	Textile finishing, except wool	316	13
386	Photographic equipment and supplies	292	14
282	Plastics materials and synthetics	271	15
349	Misc. fabricated metal products	253	16
394	Toys and sporting goods	247	17
341	Metal cans and shipping containers	241	18
283	Drugs	236	19
285	Paints and allied products	211	20
721	Laundry, cleaning, & garment services	209	21
382	Measuring and controlling devices	198	22
262	Paper mills	177	23
364	Electric lighting and wiring equipment	159	24
335	Nonferrous rolling and drawing	150	25

Exhibit 10: Top 25 Emitters of Criteria Air Pollutants
Massachusetts Industry Sectors (3-Digit SIC Level)

3 Digit SIC	Description	Criteria Air Pollutant (CAP) Rank				Composite CAP Rank
		PM10	SO_2	NO_X	CO	
491	Electric services	1	1	1	1	1
495	Sanitary services	2	3	2	2	2
262	Paper mills	3	2	5	10	3
263	Paperboard mills	4	4	6	12	4
496	Steam and air-conditioning supply	8	5	4	9	5
493	Combination utility services	5	11	3	8	6
372	Aircraft and parts	12	9	7	5	7
386	Photographic equipment and supplies	7	7	11	11	8
226	Textile finishing, except wool	9	6	9	15	9
382	Measuring and controlling devices	10	13	17	4	10
329	Misc. nonmetallic mineral products	11	16	14	7	11
289	Miscellaneous chemical products	13	12	10	18	12
209	Misc. food and kindred products	14	14	15	17	13
342	Cutlery, hand tools, and hardware	17	15	13	23	14
399	Miscellaneous manufactures	15	10	18	25	15
306	Fabricated rubber products, n.e.c.	16	19	20	20	16
308	Miscellaneous plastics products, n.e.c.	6	21	21	30	17
492	Gas production and distribution	19	53	8	6	18
281	Industrial inorganic chemicals	30	30	16	13	19
367	Electronic components and accessories	31	23	19	29	20
284	Soap, cleaners, and toilet goods	24	17	29	34	21
267	Misc. converted paper products	29	28	23	28	22
349	Misc. fabricated metal products	18	36	32	22	23
229	Miscellaneous textile goods	26	20	25	39	24
282	Plastics materials and synthetics	69	8	12	21	25

Results From Clean Water Act Data

As noted above, we received information on the annual pollutant loadings by pollutant type for the major dischargers in Massachusetts. This information was derived by US EPA from its Permit Compliance System (PCS) based on reported data. The reported data varies from permit to permit. For example, some facilities report actual loadings, others report average flow and concentration, from which loading can be calculated. In some cases, EPA calculated estimated loadings from permit maximum concentrations and/or flows. Thus caution must be used when interpreting this information.

Loading information was provided as the total for each pollutant discharged by industry sector at the 4 digit SIC number. Because there are a limited number of major dischargers in Massachusetts, only 28 4-digit SIC numbers are represented. To create a ranking, we collapsed the information to the 3-digit SIC level.

As with the BRS data, the NPDES data is of *limited utility* for conducting an environmentally based ranking of Massachusetts' industries.

- Pollutants reported are difficult to compare and in some cases are rather broad in description (e.g., volatile organics). The discharges resulting in the highest loadings are Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), both of which are associated broadly with discharge of organics. The more toxic pollutants (e.g., mercury) are overwhelmed in tonnage by these broader categories.
- NPDES permits apply only to direct discharges to water bodies. Discharges to POTWs are not subject to NPDES permitting. Because these discharges comprise the bulk of industry discharges, their absence from the NPDES data make it significantly less useful. Discharges to POTWs are regulated through the industrial pretreatment program, as specified by the Clean Water Act.

Given these limits, we were limited to ranking industries by gross generation. To do this, we summed the total loadings by industry at the 3-Digit SIC code level, and then ranked the results. The results of this ranking are presented in Exhibit 11.

As with the BRS data above, it is important to keep in mind that this ranking is based on undifferentiated annual loadings by direct dischargers: it does not take into account the differing degrees of hazard presented by different pollutants. As indicated in the exhibit, the top ranking industry is sanitary services, i.e., releases by POTWs. The waste discharge by POTWs originates both with residents and with all industries that discharge to POTWs.

Exhibit 11: Massachusetts Industry Sectors (3-Digit SIC Level) Ranked by Pounds of Undifferentiated NPDES Regulated Emissions Major NPDES Dischargers – Calendar Year 1996

3 Digit SIC	Description	Load (lbs/year)	Number of Facilities	Rank
495	Sanitary services	506,034,831	97	1
262	Paper mills	1,745,102	10	2
222	Broadwoven fabric mills, manmade	972,117	1	3
491	Electric services	803,629	13	4
226	Textile finishing, except wool	496,862	2	5
351	Engines and turbines	249,334	1	6
xxx	Invalid or missing SIC code	221,852	-	7
306	Fabricated rubber products, n.e.c.	160,088	1	8
203	Preserved fruits and vegetables	39,643	1	9
335	Nonferrous rolling and drawing	36,330	2	10
517	Petroleum and petroleum products	14,924	2	11
347	Metal services, n.e.c.	8,981	4	12
346	Metal forgings and stampings	6,478	2	13
385	Ophthalmic goods	6,321	1	14
361	Electric distributing equipment	6,042	2	15
289	Miscellaneous chemical products	3,358	2	16
221	Broadwoven fabric mills, cotton	2,162	1	17
651	Real estate operators and lessors	1,396	1	18
367	Electronic components and accessories	743	3	19
286	Industrial organic chemicals	547	2	20
362	Electrical industrial apparatus	469	1	21
366	Communication equipment	0	1	22
356	General industrial machinery	-	1	23

Results From Industrial Loadings to POTWs Data

As noted above, we received information on average daily discharges (loadings) by industry to POTWs for the period October 1996 to October 1997. We understand that this information represents monitored discharges. Each facility self-reported up to eight 4-digit SIC codes (in most cases only one or two 4-digit SIC codes were provided).

As with the information on direct discharges, this information on discharges to POTWs is of *limited utility* for conducting an environmentally based ranking of Massachusetts' industries:

- Pollutants reported present a very wide range of potential hazard and are difficult to compare.
- Three of the 139 reported pollutants—biochemical oxygen demand (5 day), total suspended solids, and oil and grease (total)—make up over 99 of reported loadings.
- Loadings of toxic pollutants (e.g., volatile organic chemicals), which can present a far greater hazard per unit, are overwhelmed in this data.
- The MWRA data represents only those businesses in its sewerage service area—44 communities in the greater Boston area. The businesses in these communities may not be representative of businesses in the state as a whole.

Given these limits, we simply ranked industries by gross loadings. We collapsed this information to 3 digit SIC codes, and developed total loadings for each 3-digit SIC code. In those cases where a facility reported multiple SIC codes, their loadings were applied to all reported SICs. We then ranked the results. The results of this ranking are presented in Exhibit 12.

> ***As with the information on direct discharges above, it is important to keep in mind that this ranking is based on undifferentiated annual loadings: it does not take into account the differing degrees of hazard presented by different pollutants.***

Exhibit 12: Massachusetts Industry Sectors (3-Digit SIC Level) Ranked by Average Daily Loading to POTWs pounds/day—October 1996 to October 1997

3 Digit SIC	Description	Average Daily Loading	Rank
289	Miscellaneous chemical products	469,185	1
202	Dairy products	389,069	2
203	Preserved fruits and vegetables	146,213	3
262	Paper mills	61,161	4
208	Beverages	53,176	5
286	Industrial organic chemicals	49,548	6
209	Misc. food and kindred products	25,086	7
386	Photographic equipment and supplies	16,953	8
369	Misc. electrical equipment & supplies	16,934	9
355	Special industry machinery	9,860	10
263	Paperboard mills	6,616	11
721	Laundry, cleaning, & garment services	6,423	12
367	Electronic components and accessories	6,188	13
333	Primary nonferrous metals	4,605	14
284	Soap, cleaners, and toilet goods	1,206	15
281	Industrial inorganic chemicals	1,137	16
358	Refrigeration and service machinery	840	17
308	Miscellaneous plastics products, n.e.c.	834	18
225	Knitting mills	394	19
223	Broadwoven fabric mills, wool	394	20
285	Paints and allied products	271	21
275	Commercial printing	203	22
347	Metal services, n.e.c.	153	23
282	Plastics materials and synthetics	75	24
381	Search and Navigation Equipment	38	25

Results from the Energy Use Data

We were provided with 1995 energy demand data for a limited set of Massachusetts industries at the 2-digit SIC code level. Information was not available at the 3-digit SIC code level. In order to allocate energy demand from the 2-digit SIC level to the 3-digit SIC level, we used wages as an admittedly imperfect proxy to prorate the information at the 2-digit SIC level to the 3-digit SIC code level.[5] We prorated based on the ratio between the total wages paid at the 3-digit level and total wages paid at the 2-digit level. For example, nonferrous rolling and drawing (SIC 335) makes up 57 percent of the wages of SIC 33, thus we assign 25 percent of the energy usage of SIC 33 to nonferrous rolling and drawing.

The results are presented in Exhibit 13.

Exhibit 13: Massachusetts Industry Sectors (3-Digit SIC Level) Ranked by 1995 Estimated Energy Demand Trillion BTUs/year

3 Digit SIC	Description	Estimated Energy Demand	Rank
335	Nonferrous rolling and drawing	13.20	1
267	Misc. converted paper products	9.25	2
357	Computer and office equipment	8.94	3
308	Miscellaneous plastics products, n.e.c.	8.85	4
283	Drugs	8.62	5
367	Electronic components and accessories	8.30	6
366	Communication equipment	6.24	7
265	Paperboard containers and boxes	5.80	8
289	Miscellaneous chemical products	5.43	9
262	Paper mills	4.91	10
342	Cutlery, hand tools, and hardware	4.83	11
282	Plastics materials and synthetics	3.79	12
382	Measuring and controlling devices	3.55	13
339	Miscellaneous primary metal products	3.33	14
344	Fabricated structural metal products	3.29	15
284	Soap, cleaners, and toilet goods	3.14	16
209	Misc. food and kindred products	2.64	17
376	Guided missiles, space vehicles, parts	2.40	18
384	Medical instruments and supplies	2.32	19
355	Special industry machinery	2.26	20
202	Dairy products	2.26	21
336	Nonferrous foundries	2.12	22
359	Industrial machinery, n.e.c.	2.05	23
331	Blast furnace and basic steel products	2.02	24
205	Bakery products	1.88	25

[5] Wages rather than number of employees (the only other available economic proxy) was chosen as a proxy for scale of operation on the business. This choice was somewhat arbitrary, as either is limited as a proxy. The ranking was also conducted using number of employees as the proxy with substantially the same results.

Results from the Water Use Data

We were provided with 1993 estimates of water use per employee for Massachusetts industries at the 2-digit SIC code level. Estimates were provided as gallons per employee per day (GED). Information was not available at the 3 digit SIC code level. In order to allocate water use from the 2-digit SIC level to the 3-digit SIC level, we multiplied the GED estimate for the appropriate 2 digit SIC by the number of employees at the 3 digit SIC level. For example, paperboard containers and boxes (SIC 265) is assigned the SIC 26 per employee water usage of 335.3 gallons per day. This is multiplied by 5,790 employees in 1996 for SIC 265, resulting in total water use of 1,941,387 gallons per day for SIC 265.

Note that although the estimates were developed for the MWRA service area, we are applying them to the entire state.

The results are presented in Exhibit 14.

Exhibit 14: Massachusetts Industry Sectors (3-Digit SIC Level) Ranked by Estimated Water Use Gallons per Day

3 Digit SIC	Description	Estimated Water Use	Rank
267	Misc. converted paper products	3,021,053	1
265	Paperboard containers and boxes	1,941,387	2
367	Electronic components and accessories	1,787,731	3
229	Miscellaneous textile goods	1,752,764	4
226	Textile finishing, except wool	1,704,937	5
209	Misc. food and kindred products	1,702,271	6
376	Guided missiles, space vehicles, parts	1,674,230	7
283	Drugs	1,659,200	8
308	Miscellaneous plastics products, n.e.c.	1,636,700	9
357	Computer and office equipment	1,577,770	10
382	Measuring and controlling devices	1,565,176	11
205	Bakery products	1,514,344	12
202	Dairy products	1,487,029	13
262	Paper mills	1,431,396	14
225	Knitting mills	1,264,468	15
222	Broadwoven fabric mills, manmade	1,146,494	16
295	Asphalt paving and roofing materials	1,040,417	17
372	Aircraft and parts	1,029,965	18
366	Communication equipment	1,001,712	19
384	Medical instruments and supplies	900,552	20
289	Miscellaneous chemical products	820,328	21
203	Preserved fruits and vegetables	807,431	22
206	Sugar and confectionery products	757,900	23
344	Fabricated structural metal products	685,429	24
342	Cutlery, hand tools, and hardware	680,201	25

Results From TURA Data

TURA collects a wealth of information on filers' chemical use and emissions. We were instructed by TURI to rank industry sectors based on three factors: 1) chemical use[6], 2) TURA "modified" TRI Data (i.e., Form R emissions data submitted to DEP [TRI + CERCLA chemicals])[7] , and 3) byproduct generation.

In order to account for the widely varying hazard of reported chemicals, we applied a draft chemical hazard weighting created by the Toxics Use Reduction Science Advisory Board. The SAB hazard weighting approach is intended as a screening device. The SAB reviewed the chemicals currently reported by TURA filers. Based on a composite of recommendations from each Board member, 42 chemicals were deemed "more hazardous" and 29 chemicals were deemed "less hazardous". SAB member recommendations were based on each member's own set of criteria and personal experience. This weighting process is still a work in progress.[8] The analysis discussed below is based on the April 1998 draft classifications, shown in Exhibit 15.

In our analysis, chemicals classed as "less hazardous" are assigned a weight of 1; chemicals classed as "more hazardous" are assigned a weight of 100; chemicals not included in either the more or less hazardous classes are assigned a weight of 10.

We first collapsed the data to arrive at the total amount of each reported chemical at the three digit SIC level. We then applied the draft SAB weights to this information to arrive at a relative overall chemical hazard weight for use in ranking the industry sectors. Exhibit 16 presents the calculation of draft TURA Use hazard weighting score for Paper Mills (SIC 262). Similar "scores" were created for each industry sector at the 3-digit SIC level for each of the three TURA factors discussed above. Rankings were developed using these scores.

The resultant rankings are shown in the following exhibits. Exhibit 17 shows the ranking based on TURA Use Data. Exhibit 18 shows the ranking based on TURA "modified" TRI Data (i.e., Form R emissions data submitted to DEP [TRI + CERCLA chemicals]). Exhibit 19 shows the ranking based on TURA Generated as Byproduct data.

In each exhibit, the final column presents a value representing the score of each industry relative to the highest ranked industry sector. This column can be used to gauge the risk potential of an industry sector relative to the others.

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[6] Use Data is the sum of the amounts classified as Manufactured, Processed and Otherwise Used. Chemicals used for treatment are excluded.

[7] Modified TRI Data is the sum of the amounts classified by TURA as Fugitive Air Emission, Point Air Emission, Discharge to Water, Underground Injection, Landfill, Land Treatment, Surface Impoundment, Other Disposal, Discharge to POTW, Transfer to Off-Site.

[8] Additional information on the SAB ranking process can be found in Appendix F of this document.

Exhibit 15: *Draft* Toxics Use Reduction Science Advisory Board Classification of TURA Chemicals — April 1998

CAS Number	Chemical Name	Draft SAB Class
107131	Acrylonitrile	High
1001	Arsenic compounds	High
1004	Cadmium compounds	High
1012	Chromium compounds	High
1026	Lead compounds	High
1029	Nickel compounds	High
1303282	Arsenic compounds	High
7440382	Arsenic	High
10108642	Cadmium compounds	High
7440439	Cadmium	High
56235	Carbon tetrachloride	High
7782505	Chlorine	High
67663	Chloroform	High
143339	Cyanide compounds (sodium cyanide)	High
96128	DBCP	High
68122	Dimethylformamide	High
106898	Epichlorohydrin	High
75218	Ethylene oxide	High
50000	Formaldehyde	High
302012	Hydrazine	High
7439921	Lead	High
7758976	Lead chromate	High
7758954	Lead compounds	High
7440020	Nickel	High
98953	Nitrobenzene	High
75445	Phosgene	High
75558	Propyleneimine	High
75569	Propyleneoxide	High
7664939	Sulfuric acid	High
8014957	Sulfuric acid (fuming)	High
127184	Tetrachloroethylene	High
584849	Toluenediisocyanates (3 CAS #s)	High
91087	Toluenediisocyanates (3 CAS #s)	High
26471625	Toluenediisocyanates (3 CAS #s)	High
79016	Trichloroethylene	High
79061	Acrylamide	High
7440473	Chromium	High
1333820	Hexavalent chromium compounds only	High
8001589	Creosote	High
64675	Diethylsulfate	High
101144	Methylenebischloroaniline	High
1336363	Pcbs	High
64197	Acetic acid	Low
67641	Acetone	Low
1344281	Aluminiumoxide	Low
7429905	Aluminum	Low
1066337	Ammoniumbicarbonate	Low
110190	Butyl acetate-i	Low
78922	Butylalcohol-sec	Low
75650	Butylalcoholc	Low
84662	Diethylphthalate	Low
131113	Dimethylphtalate	Low
141786	Ethylacetate	Low
107211	Ethyleneglycol	Low
7705080	Ferricchloride	Low
10028225	Ferricsulfate	Low
10045893	Ferrousammonium sulfate	Low
7758943	Ferrouschloride	Low
7720787	Ferroussulfate	Low
7782630	Ferroussulfate	Low
78831	Isobutyl alcohol	Low
67630	Isopropylalcohol	Low
67561	Methanol	Low
78933	Methylethylketone	Low
7631905	Sodium bisulfite	Low
7558294	Sodium phosphate, tribasic	Low
7601549	Sodium phosphate, tribasic	Low
7758294	Sodium phosphate, tribasic	Low
10101890	Sodium phosphate, tribasic	Low
7440666	Zinc	Low
1039	Zinc and compounds	Low

Note: All TURA-listed chemicals not included here are middle ranked.

Exhibit 16: Calculation of Draft **TURA Use** Hazard Weighting Score for Paper Mills (SIC 262)

Chemical Information			TURA Use Totals (pounds) and Draft Hazard Weightings				
Chemical Name	CAS #	SAB Draft Weight	Manufactured	Processed	Otherwise Used	Total Use	Hazard Weighting
Sulfuric Acid	7664939	100	52,531	-	5,584,379	5,636,910	563,691,000
Sodium Hypochlorite	7681529	10	-	17,472	6,177,161	6,194,633	61,946,330
Sodium Hydroxide	1310732	10	-	93,745	4,011,020	4,104,765	41,047,650
Aluminum Sulfate	10043013	10	-	294,130	1,495,158	1,789,288	17,892,880
Formaldehyde	50000	100	-	158,756	-	158,756	15,875,600
Chlorine	7782505	100	-	-	34,148	34,148	3,414,800
Phosphoric Acid	7664382	10	-	18,716	151,501	170,217	1,702,170
Ferric Chloride	7705080	1	-	-	1,415,636	1,415,636	1,415,636
Ferric Sulfate	10028225	1	-	-	1,242,408	1,242,408	1,242,408
Copper Compounds	1015	10	-	113,899	-	113,899	1,138,990
Ammonia	7664417	10	17,000	68,734	24,000	109,734	1,097,340
Sodium Bisulfite	7631905	1	-	-	939,950	939,950	939,950
Ferrous Chloride	7758943	1	-	-	720,000	720,000	720,000
Potassium Hydroxide	1310583	10	-	-	41,200	41,200	412,000
Calcium Hypochlorite	7778543	10	-	-	32,850	32,850	328,500
Phenol	108952	10	-	22,000	-	22,000	220,000
Ci Direct Blue 218	28407376	10	-	18,542	-	18,542	185,420
Sodium Hydrosulfide	16721805	10	-	-	16,106	16,106	161,060
Ethylene bis Dithiocarbamate	142596	10	-	-	14,142	14,142	141,420
Sodium Dimethyldithiocarbamate	128041	10	-	-	14,142	14,142	141,420
Acetic Acid	64197	1	-	47,669	73,981	121,650	121,650
Methylethylketone	78933	1	-	-	76,270	76,270	76,270
Zinc and Compounds	1039	1	-	70,000	-	70,000	70,000
Acetone	67641	1	-	-	60,934	60,934	60,934
Methanol	67561	1	-	48,000	-	48,000	48,000
Totals						**23,166,180**	**714,091,428**

Exhibit 17: Ranking of Massachusetts Industry at 3-Digit SIC Code Level
Applying *Draft* SAB Hazard Rankings to
1995 TURA Use Data
Top 25 Sectors

3 Digit SIC	Description	Hazard Rank	Relative Hazard Weighting (top ranking = 100)
282	Plastics materials and synthetics	1	100.0
289	Miscellaneous chemical products	2	46.3
308	Miscellaneous plastics products, n.e.c.	3	37.1
516	Chemicals and allied products	4	20.1
335	Nonferrous rolling and drawing	5	20.0
346	Metal forgings and stampings	6	16.6
262	Paper mills	7	15.0
286	Industrial organic chemicals	8	13.6
491	Electric services	9	12.7
367	Electronic components and accessories	10	9.9
347	Metal services, n.e.c.	11	9.5
226	Textile finishing, except wool	12	8.9
xxx	[Invalid or Missing SIC Code]	13	8.2
364	Electric lighting and wiring equipment	14	8.1
334	Secondary nonferrous metals	15	7.1
284	Soap, cleaners, and toilet goods	16	6.4
329	Misc. nonmetallic mineral products	17	6.3
285	Paints and allied products	18	6.1
281	Industrial inorganic chemicals	19	4.5
349	Misc. fabricated metal products	20	4.4
229	Miscellaneous textile goods	21	3.7
372	Aircraft and parts	22	3.1
249	Miscellaneous wood products	23	2.8
386	Photographic equipment and supplies	24	2.4
496	Steam and air-conditioning supply	25	2.3

Exhibit 18: Ranking of Massachusetts Industry at 3-Digit SIC Code Level
Applying *Draft* SAB Hazard Rankings to
1995 TURA "Modified" TRI Data (TRI + CERCLA Chemicals)
Top 25 Sectors

3 Digit SIC	Description	Hazard Rank	Relative Hazard Weighting (top ranking = 100)
491	Electric services	1	100.0
367	Electronic components and accessories	2	16.2
262	Paper mills	3	13.7
347	Metal services, n.e.c.	4	12.9
346	Metal forgings and stampings	5	11.3
308	Miscellaneous plastics products, n.e.c.	6	10.2
229	Miscellaneous textile goods	7	7.5
282	Plastics materials and synthetics	8	7.5
335	Nonferrous rolling and drawing	9	5.5
226	Textile finishing, except wool	10	4.4
267	Misc. converted paper products	11	4.0
364	Electric lighting and wiring equipment	12	3.3
341	Metal cans and shipping containers	13	2.3
386	Photographic equipment and supplies	14	2.0
331	Blast furnace and basic steel products	15	2.0
305	Hose & belting & gaskets & packing	16	2.0
342	Cutlery, hand tools, and hardware	17	1.7
721	Laundry, cleaning, & garment services	18	1.7
306	Fabricated rubber products, n.e.c.	19	1.6
275	Commercial printing	20	1.5
372	Aircraft and parts	21	1.4
289	Miscellaneous chemical products	22	1.2
399	Miscellaneous manufactures	23	1.1
394	Toys and sporting goods	24	1.1
384	Medical instruments and supplies	25	1.0

Exhibit 19: Ranking of Massachusetts Industry at 3-Digit SIC Code Level
Applying *Draft* SAB Hazard Rankings to
1995 TURA Generated as Byproduct Data
Top 25 Sectors

3 Digit SIC	Description	Hazard Rank	Relative Hazard Weighting (top ranking = 100)
491	Electric services	1	100.0
367	Electronic components and accessories	2	94.7
262	Paper mills	3	81.0
347	Metal services, n.e.c.	4	79.0
289	Miscellaneous chemical products	5	59.8
282	Plastics materials and synthetics	6	55.7
229	Miscellaneous textile goods	7	51.0
346	Metal forgings and stampings	8	32.7
226	Textile finishing, except wool	9	30.0
335	Nonferrous rolling and drawing	10	26.9
372	Aircraft and parts	11	25.6
286	Industrial organic chemicals	12	22.3
308	Miscellaneous plastics products, n.e.c.	13	18.3
386	Photographic equipment and supplies	14	18.0
364	Electric lighting and wiring equipment	15	17.0
267	Misc. converted paper products	16	15.4
275	Commercial printing	17	13.6
493	Combination utility services	18	12.3
384	Medical instruments and supplies	19	11.2
349	Misc. fabricated metal products	20	10.7
284	Soap, cleaners, and toilet goods	21	9.6
496	Steam and air-conditioning supply	22	8.9
334	Secondary nonferrous metals	23	8.4
341	Metal cans and shipping containers	24	8.3
285	Paints and allied products	25	6.9

COMBINING ECONOMIC AND ENVIRONMENTAL DATA

Exhibit 20 presents the environmental rankings from above for the industries ranked in the top 100 in the economic screening. Blank cells indicate that the industry did not appear in the relevant database.

Exhibit 21 presents the same information as Exhibit 20 using symbols rather than numbers. Those industries ranked in the top third of any of the indicators are marked with a "+" in the relevant column. Those industries ranked in the second third are marked with a "–", and all others are left blank.

Exhibit 20: Summary Environmental Ranking of Massachusetts Industry at 3 Digit SIC Level
Top 100 Economic Ranked Industries Only

3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	Air Data		NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	Hazard Rank Based On		
				CAPs	VOCs					TURA Use	TURA Modified TRI	TURA Generated as Byproduct
737	Computer and data processing services	1	78									
736	Personnel supply services	2										
504	Professional & commercial equipment	3										
506	Electrical goods	4	84									
738	Miscellaneous business services	5	75									
734	Services to buildings	6										
514	Groceries and related products	7										
508	Machinery, equipment, and supplies	8										
753	Automotive repair shops	9	80									
367	Electronic components and accessories	10	1	20	10	19	13	6		10	2	2
733	Mailing, reproduction, stenographic	11	63									
308	Miscellaneous plastics products, n.e.c.	12	33	17	1		18	4		3	6	13
519	Misc. nondurable goods	13							3			
382	Measuring and controlling devices	14	17	10	22		35	13		48	30	39
451	Air transportation, scheduled	15		86	86				9	83	55	67
359	Industrial machinery, n.e.c.	16	77					23				
275	Commercial printing	17	25	32	4		22	46	11	32	20	17
501	Motor vehicles & automotive equipment	18										
723	Beauty shops	19							31			
472	Arrangement of transportation	20							30			
344	Fabricated structural metal products	21	57	58	29		49	15		58	49	72
509	Miscellaneous durable goods	22	28									
512	Drugs, proprietaries, and sundries	23										
355	Special industry machinery	24	31	53	40		10	20	24	42	47	26
503	Lumber and construction materials	25										
731	Advertising	26										
354	Metalworking machinery	27	55					32	32			
272	Periodicals	28						66				
721	Laundry, cleaning, & garment services	29	29	28	21		12			36	18	35
502	Furniture and home furnishings	30							34			
356	General industrial machinery	31	42	48	41	23	27	34	52	62	45	47
283	Drugs	32	35	41	19		32	5		52	64	44
507	Hardware, plumbing & heating	33										
735	Misc. equipment rental & leasing	34							38			
384	Medical instruments and supplies	35	30	57	39		43	19	8	33	25	19
754	Automotive services, except repair	36										
335	Nonferrous rolling and drawing	37	14	40	25	10		1		5	9	10
347	Metal services, n.e.c.	38	2	29	8	12	23	28	20	11	4	4
273	Books	39						67				
495	Sanitary services	40	40	2	9	1	26		27	28	78	86
516	Chemicals and allied products	41	38	82	70				36	4	39	46
483	Radio and television broadcasting	42							51			
364	Electric lighting and wiring equipment	43	39	45	24		36	36		14	12	15
751	Automotive rentals, no drivers	44										
769	Miscellaneous repair shops	45	68	56	56					86	52	76
209	Misc. food and kindred products	46		13	47		7	17	42	66	41	59
176	Roofing and Sheet Metal Work	47		75	83					64	82	68
518	Beer, wine, and distilled beverages	48										
481	Telephone communication	49							6			
484	Cable and other pay TV services	50										
399	Miscellaneous manufactures	51	20	15	34		44			60	23	45
271	Newspapers	52	53					51				
513	Apparel, piece goods and notions	53										
357	Computer and office equipment	54	7	65	32		28	3		61	57	36
265	Paperboard containers and boxes	55	58	27	36		37	8	33	72	53	74
239	Misc. fabricated textile products	56		79	77		47	48		74	54	78
205	Bakery products	57						25	10			
362	Electrical industrial apparatus	58	66			21		37	2			
511	Paper and paper products	59							68			
274	Miscellaneous publishing	60						69	12			
505	Metals and minerals, except petroleum	61							43			
366	Communication equipment	62	10			22		7				
289	Miscellaneous chemical products	63	24	12	26	16	1	9	64	2	22	5
342	Cutlery, hand tools, and hardware	64	12	14	33		46	11		29	17	28
517	Petroleum and petroleum products	65	21	33	5	11			19	53	74	83

Exhibit 20: Summary Environmental Ranking of Massachusetts Industry at 3 Digit SIC Level
Top 100 Economic Ranked Industries Only

3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	Air Data		NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	Hazard Rank Based On		
				CAPs	VOCs					TURA Use	TURA Modified TRI	TURA Generated as Byproduct
267	Misc. converted paper products	66	22	22	3			2	21	30	11	16
491	Electric services	67	56	1	7	4	39		25	9	1	1
358	Refrigeration and service machinery	68		84	60		17	59		46	50	32
473	Freight transportation arrangement	69							1			
752	Automobile parking	70										
202	Dairy products	71	88	31	78		2	21	59	35	46	31
327	Concrete, gypsum, and plaster products	72										
345	Screw machine products, bolts, etc.	73	26	69	59		42	49		67	28	53
226	Textile finishing, except wool	74	47	9	13	5	30	43	13	12	10	9
243	Millwork, plywood & structural members	75										
726	Funeral service and crematories	76							55			
449	Water transportation services	77							5			
394	Toys and sporting goods	78	49	26	17					41	24	41
349	Misc. fabricated metal products	79	5	23	16		38	27		20	31	20
371	Motor vehicles and equipment	80	81	67	67		33	71		54	69	61
306	Fabricated rubber products, n.e.c.	81	54	16	6	8		29		37	19	29
346	Metal forgings and stampings	82	8	37	38	13	40	26	41	6	5	8
381	Search and Navigation Equipment	83	73	85	49		25	39	49	70	37	51
208	Beverages	84		35	79		5	45	46	49	80	48
279	Printing trade services	85		78	61		51	83	44	78	67	57
391	Jewelry, silverware, and plated ware	86	11	38	42		45		39	47	61	56
722	Photographic studios, portrait	87							28			
492	Gas production and distribution	88	67	18	30				77	73	85	54
229	Miscellaneous textile goods	89	46	24	2		29	40		21	7	7
386	Photographic equipment and supplies	90	4	8	14		8	42		24	14	14
262	Paper mills	91	79	3	23	2	4	10		7	3	3
372	Aircraft and parts	92	9	7	31		41	38	4	22	21	11
201	Meat products	93						52	37			
251	Household furniture	94	60	39	11				14	77	34	55
233	Women's and misses' outerwear	95						44	18			
206	Sugar and confectionery products	96						56	26			
762	Electrical repair shops	97										
732	Credit reporting and collection	98							71			
329	Misc. nonmetallic mineral products	99	52	11	35				23	17	33	58
254	Partitions and fixtures	100		71	68					85	51	75

Exhibit 21: Summary Ranking of the Top 100 Economically Ranked Massachusetts Industries
("+" = rank in top third, "-" = rank in second third, blank = remainder)

3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	Air Data: CAPs	Air Data: VOCs	NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	Hazard Rank Based On: TURA Use	TURA Modified TRI	TURA Generated as Byproduct
737	Computer and data processing services	+										
736	Personnel supply services	+										
504	Professional & commercial equipment	+										
506	Electrical goods	+										
738	Miscellaneous business services	+										
734	Services to buildings	+										
514	Groceries and related products	+										
508	Machinery, equipment, and supplies	+										
753	Automotive repair shops	+										
367	Electronic components and accessories	+	+	+	+		+	+		+	+	+
733	Mailing, reproduction, stenographic	+										
308	Miscellaneous plastics products, n.e.c.	+	-	+	+		-	+		+	+	+
519	Misc. nondurable goods	+							+			
382	Measuring and controlling devices	+	+	+	+		-	+		-	-	-
451	Air transportation, scheduled	+							+		-	
359	Industrial machinery, n.e.c.	+						+				
275	Commercial printing	+	+	-	+		-	-	+	-	+	+
501	Motor vehicles & automotive equipment	+										
723	Beauty shops	+							+			
472	Arrangement of transportation	+							+			
344	Fabricated structural metal products	+	-	-	+			+		-	-	
509	Miscellaneous durable goods	+	+									
512	Drugs, proprietaries, and sundries	+										
355	Special industry machinery	+	-	-	-		+	+	+	-	-	+
503	Lumber and construction materials	+										
731	Advertising	+										
354	Metalworking machinery	+	-					+	+			
272	Periodicals	+										
721	Laundry, cleaning, & garment services	+	+	+	+		+			-	+	-
502	Furniture and home furnishings	+							-			
356	General industrial machinery	+	-	-	-		-	-	-		-	-
283	Drugs	+	-	-	+		-	+		-		-
507	Hardware, plumbing & heating	+										
735	Misc. equipment rental & leasing	-							-			
384	Medical instruments and supplies	-	-	-	-			+	+	-	+	+
754	Automotive services, except repair	-										
335	Nonferrous rolling and drawing	-	+	-	+	-		+		+	+	+
347	Metal services, n.e.c.	-	+	+	+	-	-	+	+	+	+	+
273	Books	-										
495	Sanitary services	-	-	+	+	+	-		+	+		
516	Chemicals and allied products	-	-						-	+	-	-
483	Radio and television broadcasting	-							-			
364	Electric lighting and wiring equipment	-	-	-	+			-		+	+	+
751	Automotive rentals, no drivers	-										
769	Miscellaneous repair shops	-		-	-						-	
209	Misc. food and kindred products	-		+	-		+	+	-		-	
176	Roofing and Sheet Metal Work	-										
518	Beer, wine, and distilled beverages	-										
481	Telephone communication	-							+			
484	Cable and other pay TV services	-										
399	Miscellaneous manufactures	-	+	+	-						+	-
271	Newspapers	-	-					-				
513	Apparel, piece goods and notions	-										
357	Computer and office equipment	-	+		-		-	+			-	-
265	Paperboard containers and boxes	-	-	+	-			+	-		-	
239	Misc. fabricated textile products	-						-			-	
205	Bakery products	-						+	+			
362	Electrical industrial apparatus	-						-	+			
511	Paper and paper products	-										
274	Miscellaneous publishing	-							+			
505	Metals and minerals, except petroleum	-							-			
366	Communication equipment	-	+					+				
289	Miscellaneous chemical products	-	+	+	+		+	+	-	+	+	+
342	Cutlery, hand tools, and hardware	-	+	+	-			+		+	+	+
517	Petroleum and petroleum products	-	+	-	+	-			+	-		

Exhibit 21: Summary Ranking of the Top 100 Economically Ranked Massachusetts Industries
("+" = rank in top third, "-" = rank in second third, blank = remainder)

3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	Air Data		NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	Hazard Rank Based On		
				CAPs	VOCs					TURA Use	TURA Modified TRI	TURA Generated as Byproduct
267	Misc. converted paper products	-	+	+	+			+	+	-	+	+
491	Electric services		-	+	+	+			+	+	+	+
358	Refrigeration and service machinery						+	-		-	-	-
473	Freight transportation arrangement								+			
752	Automobile parking											
202	Dairy products			-			+	+	-	-	-	-
327	Concrete, gypsum, and plaster products											
345	Screw machine products, bolts, etc.		+					-			+	-
226	Textile finishing, except wool		-	+	+	+	-	-	+	+	+	+
243	Millwork, plywood & structural members											
726	Funeral service and crematories								-			
449	Water transportation services								+			
394	Toys and sporting goods		-	+	+					-	+	-
349	Misc. fabricated metal products		+	+	+			+		+	-	+
371	Motor vehicles and equipment						-			-		
306	Fabricated rubber products, n.e.c.		-	+	+	-		+		-	+	+
346	Metal forgings and stampings		+	-	-	-		+	-	+	+	+
381	Search and Navigation Equipment				-		-	-	-		-	-
208	Beverages			-			+	-	-	-		-
279	Printing trade services								-			-
391	Jewelry, silverware, and plated ware		+	-	-				-	-		-
722	Photographic studios, portrait								+			
492	Gas production and distribution			+	-							-
229	Miscellaneous textile goods		-	+	+		-	-		+	+	+
386	Photographic equipment and supplies		+	+	+		+	-		+	+	+
262	Paper mills			+	+	+	+	+		+	+	+
372	Aircraft and parts		+	+	-			-	+	+	+	+
201	Meat products							-	-			
251	Household furniture			-	+				+		-	-
233	Women's and misses' outerwear							-	+			
206	Sugar and confectionery products							-	+			
762	Electrical repair shops											
732	Credit reporting and collection											
329	Misc. nonmetallic mineral products		-	+	-				+	+	-	-
254	Partitions and fixtures										-	

CONCLUSIONS

Based on the exhibits above, it appears that the following industries are the best candidates for further focus, as they rank high on both the economic and environmental indicators (i.e., they have a "+" in the economic ranking column and a "+" or "–" in at least five environmental indicators). Those in **bold text** have a particularly high environmental rank (i.e., they have a "+" in at least five environmental indicators.

3 Digit SIC	Description
367	**Electronic components and accessories**
308	**Miscellaneous plastics products, n.e.c.**
382	Measuring and controlling devices
275	**Commercial printing**
344	Fabricated structural metal products
355	Special industry machinery
721	**Laundry, cleaning, & garment services**
356	General industrial machinery
283	Drugs

The following are second tier candidates, as they rank lower in the economic screen, but high in the environmental screen (i.e., they have a "–" in the economic ranking, and "+" or "–" in at least five environmental indicators). Those in **bold text** have a particularly high environmental rank (i.e., they have a "+" in at least five environmental indicators.

3 Digit SIC	Description	3 Digit SIC	Description
384	Medical instruments and supplies	399	Miscellaneous manufactures
335	**Nonferrous rolling and drawing**	357	Computer and office equipment
347	**Metal services, n.e.c.**	265	Paperboard containers and boxes
495	**Sanitary services**	**289**	**Miscellaneous chemical products**
516	Chemicals and allied products	**342**	**Cutlery, hand tools, and hardware**
364	Electric lighting and wiring equipment	517	Petroleum and petroleum products
209	Misc. food and kindred products	**267**	**Misc. converted paper products**

The following are third tier candidates—those with the lowest economic ranking yet with high environmental ranking (i.e., they have a blank in the economic ranking, and "+" or "–" in at least five environmental indicators). Those in **bold text** have a particularly high environmental rank (i.e., they have a "+" in at least five environmental indicators.

3 Digit SIC	Description	3 Digit SIC	Description
491	**Electric services**	208	Beverages
358	Refrigeration and service machinery	391	Jewelry, silverware, and plated ware
202	Dairy products	**229**	**Miscellaneous textile goods**
226	**Textile finishing, except wool**	**386**	**Photographic equipment and supplies**
394	Toys and sporting goods	**262**	**Paper mills**
349	**Misc. fabricated metal products**	**372**	**Aircraft and parts**
306	**Fabricated rubber products, n.e.c.**	251	Household furniture
346	**Metal forgings and stampings**	329	Misc. nonmetallic mineral products
381	Search and navigation equipment		

Exhibit 22, on the following page, provides the economic and environmental category rankings for the industry sectors in the three tiers above.

Exhibit 22: Summary Economic and Environmental Ranking of Massachusetts Industry at 3 Digit SIC Level First, Second, and Third Tier Summary Groups Only—High Environmental Rankers in Bold Text

3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	Air Data		NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	Hazard Rank Based On		
				CAPs	VOCs					TURA Use	TURA Modified TRI	TURA Generated as Byproduct
FIRST TIER												
367	**Electronic components and accessories**	**10**	**1**	**20**	**10**	**19**	**13**	**6**		**10**	**2**	**2**
308	**Miscellaneous plastics products, n.e.c.**	**12**	**33**	**17**	**1**		**18**	**4**		**3**	**6**	**13**
382	Measuring and controlling devices	14	17	10	22		35	13		48	30	39
275	**Commercial printing**	**17**	**25**	**32**	**4**		**22**	**46**	**11**	**32**	**20**	**17**
344	Fabricated structural metal products	21	57	58	29		49	15		58	49	72
355	Special industry machinery	24	31	53	40		10	20	24	42	47	26
721	**Laundry, cleaning, & garment services**	**29**	**29**	**28**	**21**		**12**			**36**	**18**	**35**
356	General industrial machinery	31	42	48	41	23	27	34	52	62	45	47
283	Drugs	32	35	41	19		32	5		52	64	44
SECOND TIER												
384	Medical instruments and supplies	35	30	57	39		43	19	8	33	25	19
335	**Nonferrous rolling and drawing**	**37**	**14**	**40**	**25**	**10**		**1**		**5**	**9**	**10**
347	**Metal services, n.e.c.**	**38**	**2**	**29**	**8**	**12**	**23**	**28**	**20**	**11**	**4**	**4**
495	**Sanitary services**	**40**	**40**	**2**	**9**	**1**	**26**		**27**	**28**	**78**	**86**
516	Chemicals and allied products	41	38	82	70				36	4	39	46
364	Electric lighting and wiring equipment	43	39	45	24		36	36		14	12	15
209	Misc. food and kindred products	46		13	47		7	17	42	66	41	59
399	Miscellaneous manufactures	51	20	15	34		44			60	23	45
357	Computer and office equipment	54	7	65	32		28	3		61	57	36
265	Paperboard containers and boxes	55	58	27	36		37	8	33	72	53	74
289	**Miscellaneous chemical products**	**63**	**24**	**12**	**26**	**16**	**1**	**9**	**64**	**2**	**22**	**5**
342	**Cutlery, hand tools, and hardware**	**64**	**12**	**14**	**33**		**46**	**11**		**29**	**17**	**28**
517	Petroleum and petroleum products	65	21	33	5	11			19	53	74	83
267	**Misc. converted paper products**	**66**	**22**	**22**	**3**			**2**	**21**	**30**	**11**	**16**
THIRD TIER												
491	**Electric services**	**67**	**56**	**1**	**7**	**4**	**39**		**25**	**9**	**1**	**1**
358	Refrigeration and service machinery	68		84	60		17	59		46	50	32
202	Dairy products	71	88	31	78		2	21	59	35	46	31
226	**Textile finishing, except wool**	**74**	**47**	**9**	**13**	**5**	**30**	**43**	**13**	**12**	**10**	**9**
394	Toys and sporting goods	78	49	26	17					41	24	41
349	**Misc. fabricated metal products**	**79**	**5**	**23**	**16**		**38**	**27**		**20**	**31**	**20**
306	**Fabricated rubber products, n.e.c.**	**81**	**54**	**16**	**6**	**8**		**29**		**37**	**19**	**29**
346	**Metal forgings and stampings**	**82**	**8**	**37**	**38**	**13**	**40**	**26**	**41**	**6**	**5**	**8**
381	Search and Navigation Equipment	83	73	85	49		25	39	49	70	37	51
208	Beverages	84		35	79		5	45	46	49	80	48
391	Jewelry, silverware, and plated ware	86	11	38	42		45		39	47	61	56
229	**Miscellaneous textile goods**	**89**	**46**	**24**	**2**		**29**	**40**		**21**	**7**	**7**
386	**Photographic equipment and supplies**	**90**	**4**	**8**	**14**		**8**	**42**		**24**	**14**	**14**
262	**Paper mills**	**91**	**79**	**3**	**23**	**2**	**4**	**10**		**7**	**3**	**3**
372	**Aircraft and parts**	**92**	**9**	**7**	**31**		**41**	**38**	**4**	**22**	**21**	**11**
251	Household furniture	94	60	39	11				14	77	34	55
329	Misc. nonmetallic mineral products	99	52	11	35				23	17	33	58

APPENDICES

The following appendices are organized as follows:

Appendix A: Tables Detailing Key Economic Indicators

This appendix provides details on the key economic indicators used in the analysis.

Appendix B: Additional Tables on the Massachusetts Economy

This appendix provides tables that present additional information on the Massachusetts economy.

Appendix C: Sources of Massachusetts Economic Information on the Internet

This appendix provides details on the Internet location of the Massachusetts economic information analyzed.

Appendix D: Additional Exhibits Ranking Massachusetts Industries Based on Environmental Data

This appendix provides tables that present additional information on the ranking of Massachusetts industries based on environmental data.

Appendix E: Information on TURA Filings by Economic Sector

This appendix provides tables that present information on the number and percentage of TURA filers at the 3 and 4 digit SIC level.

APPENDIX A: TABLES DETAILING KEY ECONOMIC INDICATORS

This appendix presents four tables, each presenting details on the key economic indicators used to rank sectors of the Massachusetts economy. These tables were derived from the State of Massachusetts Employment and Wages (ES-202) Information and the information on TURA filers provided by TURI.

Exhibit 23: Top 25 Sectors of the Massachusetts Economy (3 Digit SICs) with Ten or More Employees by Number of Firms

Rank	3 Digit SIC	Description	# of TURA Filers	% of Sector Filed	Number of Firms (1996)	Average # Employees (1996)
1	737	Computer and data processing services	0	0	4,105	16
2	504	Professional & commercial equipment	0	0	2,920	11
3	738	Miscellaneous business services	1	0	2,814	11
4	506	Electrical goods	0	0	1,909	11
5	514	Groceries and related products	0	0	1,618	14
6	734	Services to buildings	0	0	1,492	19
7	736	Personnel supply services	0	0	1,191	56
8	519	Misc. nondurable goods	1	0	1,037	11
9	733	Mailing, reproduction, stenographic	0	0	972	11
10	501	Motor vehicles & automotive equipment	0	0	926	10
11	275	Commercial printing	8	1	837	19
12	359	Industrial machinery, n.e.c.	1	0	782	12
13	513	Apparel, piece goods and notions	0	0	665	16
14	511	Paper and paper products	0	0	596	11
15	481	Telephone communication	0	0	489	39
16	308	Miscellaneous plastics products, n.e.c.	55	14	407	49
17	354	Metalworking machinery	6	1	404	21
18	344	Fabricated structural metal products	6	2	374	21
19	751	Automotive rentals, no drivers	0	0	371	12
20	512	Drugs, proprietaries, and sundries	0	0	362	17
21	367	Electronic components and accessories	78	23	338	81
22	272	Periodicals	0	0	328	16
23	382	Measuring and controlling devices	20	7	304	79
24	495	Sanitary services	8	3	295	18
25	271	Newspapers	0	0	218	65

Exhibit 24: Top 25 Sectors of the Massachusetts Economy (3 Digit SICs) with Ten or More Employees by Size of Payroll

Rank	3 Digit SIC	Description	# of TURA Filers	% of Sector Filed	Total Wages for Last quarter of 1996 ($1,000)
1	737	Computer and data processing services	0	0	1,123,629
2	504	Professional & commercial equipment	0	0	497,664
3	357	Computer and office equipment	5	3	450,122
4	736	Personnel supply services	0	0	373,606
5	367	Electronic components and accessories	78	23	318,042
6	506	Electrical goods	0	0	314,729
7	382	Measuring and controlling devices	20	7	291,201
8	481	Telephone communication	0	0	249,041
9	514	Groceries and related products	0	0	248,794
10	366	Communication equipment	7	9	239,014
11	308	Miscellaneous plastics products, n.e.c.	55	14	191,540
12	384	Medical instruments and supplies	14	9	189,917
13	738	Miscellaneous business services	1	0	185,475
14	451	Air transportation, scheduled	4	2	174,387
15	491	Electric services	22	22	150,007
16	275	Commercial printing	8	1	149,450
17	376	Guided missiles, space vehicles, parts	0	0	133,550
18	513	Apparel, piece goods and notions	0	0	127,537
19	271	Newspapers	0	0	124,957
20	342	Cutlery, hand tools, and hardware	14	24	121,152
21	733	Mailing, reproduction, stenographic	0	0	115,897
22	381	Search and Navigation Equipment	7	17	115,730
23	355	Special industry machinery	10	6	113,896
24	359	Industrial machinery, n.e.c.	1	0	102,988
25	734	Services to buildings	0	0	101,188

Exhibit 25: Top 25 Sectors of the Massachusetts Economy (3 Digit SICs) with Ten or More Employees by Number of Employees

Rank	3 Digit SIC	Description	# of TURA Filers	% of Sector Filed	Total Number of Employees in Last quarter of 1996
1	736	Personnel supply services	0	0	66,467
2	737	Computer and data processing services	0	0	65,296
3	504	Professional & commercial equipment	0	0	31,522
4	738	Miscellaneous business services	1	0	31,046
5	734	Services to buildings	0	0	28,180
6	367	Electronic components and accessories	78	23	27,252
7	357	Computer and office equipment	5	3	25,204
8	382	Measuring and controlling devices	20	7	23,969
9	514	Groceries and related products	0	0	22,885
10	451	Air transportation, scheduled	4	2	21,640
11	506	Electrical goods	0	0	20,417
12	308	Miscellaneous plastics products, n.e.c.	55	14	19,887
13	481	Telephone communication	0	0	19,278
14	275	Commercial printing	8	1	15,499
15	366	Communication equipment	7	9	15,270
16	271	Newspapers	0	0	14,224
17	384	Medical instruments and supplies	14	9	13,791
18	519	Misc. nondurable goods	1	0	11,652
19	513	Apparel, piece goods and notions	0	0	10,675
20	733	Mailing, reproduction, stenographic	0	0	10,292
21	376	Guided missiles, space vehicles, parts	0	0	10,153
22	491	Electric services	22	22	9,884
23	501	Motor vehicles & automotive equipment	0	0	9,706
24	359	Industrial machinery, n.e.c.	1	0	9,630
25	355	Special industry machinery	10	6	9,425

Exhibit 26: Top 25 Sectors of the Massachusetts Economy (3 Digit SICs) with Ten or More Employees by Change in Number of Employees—1993-1996

Rank	3 Digit SIC	Description	# of TURA Filers	% of Sector Filed	Number of Employees 1993	Number of Employees 4th Qtr. 1996	Number of Employees Change 1993-1996
1	736	Personnel supply services	0	0	39,977	66,467	26,490
2	737	Computer and data processing services	0	0	42,782	65,296	22,514
3	451	Air transportation, scheduled	4	2	11,962	21,640	9,678
4	506	Electrical goods	0	0	14,861	20,417	5,556
5	734	Services to buildings	0	0	24,794	28,180	3,386
6	733	Mailing, reproduction, stenographic	0	0	7,376	10,292	2,916
7	738	Miscellaneous business services	1	0	28,224	31,046	2,822
8	283	Drugs	9	14	4,711	6,800	2,089
9	359	Industrial machinery, n.e.c.	1	0	7,631	9,630	1,999
10	367	Electronic components and accessories	78	23	25,387	27,252	1,865
11	519	Misc. nondurable goods	1	0	9,900	11,652	1,752
12	335	Nonferrous rolling and drawing	30	38	4,009	5,647	1,638
13	504	Professional & commercial equipment	0	0	30,020	31,522	1,502
14	308	Miscellaneous plastics products, n.e.c.	55	14	18,489	19,887	1,398
15	382	Measuring and controlling devices	20	7	22,603	23,969	1,366
16	512	Drugs, proprietaries, and sundries	0	0	4,972	6,203	1,231
17	514	Groceries and related products	0	0	21,677	22,885	1,208
18	344	Fabricated structural metal products	6	2	6,896	7,998	1,102
19	272	Periodicals	0	0	4,143	5,235	1,092
20	356	General industrial machinery	9	6	5,832	6,871	1,039
21	347	Metal services, n.e.c.	60	28	4,066	5,102	1,036
22	501	Motor vehicles & automotive equipment	0	0	8,798	9,706	908
23	358	Refrigeration and service machinery	3	7	1,517	2,378	861
24	355	Special industry machinery	10	6	8,576	9,425	849
25	364	Electric lighting and wiring equipment	15	20	4,677	5,522	845

Exhibit 27: Top 25 Ranking Massachusetts TURA Industries by Key Economic Indicators
3 Digit SIC Level
***Excluding* 4 Digit SIC Level Sectors Averaging 9 or Fewer Employees per Firm**

Industry Identification		Rank by Economic Indicator					
3 Digit SIC	Description	Number of Firms	Size of Payroll	Number of Employees	Increase in Number of Employees	Average of Ranks	Percent of Firms TURA Filers
737	Computer and data processing services	1	1	2	2	2	0.00
736	Personnel supply services	7	4	1	1	3	0.00
504	Professional & commercial equipment	2	2	3	13	5	0.00
506	Electrical goods	4	6	11	4	6	0.00
738	Miscellaneous business services	3	13	4	7	7	0.04
514	Groceries and related products	5	9	9	17	10	0.00
734	Services to buildings	6	25	5	5	10	0.00
367	Electronic components and accessories	21	5	6	10	11	23.08
308	Miscellaneous plastics products, n.e.c.	16	11	12	14	13	13.51
382	Measuring and controlling devices	23	7	8	15	13	6.58
451	Air transportation, scheduled	29	14	10	3	14	2.09
733	Mailing, reproduction, stenographic	9	21	20	6	14	0.00
519	Misc. nondurable goods	8	26	18	11	16	0.10
359	Industrial machinery, n.e.c.	12	24	24	9	17	0.13
275	Commercial printing	11	16	14	39	20	0.96
501	Motor vehicles & automotive equipment	10	28	23	22	21	0.00
344	Fabricated structural metal products	18	34	28	18	25	1.60
512	Drugs, proprietaries, and sundries	20	30	36	16	26	0.00
355	Special industry machinery	31	23	25	24	26	6.02
354	*Metalworking machinery*	*17*	*31*	*27*	*40*	*29*	*1.49*
272	*Periodicals*	*22*	*37*	*44*	*19*	*31*	*0.00*
356	*General industrial machinery*	*38*	*35*	*30*	*20*	*31*	*6.43*
384	*Medical instruments and supplies*	*33*	*12*	*17*	*71*	*33*	*8.64*
283	*Drugs*	*62*	*33*	*31*	*8*	*34*	*13.64*
273	*Books*	*30*	*40*	*38*	*37*	*36*	*0.56*

APPENDIX B: ADDITIONAL TABLES ON THE MASSACHUSETTS ECONOMY

This appendix contains additional tables summarizing the state of the Massachusetts economy.

Exhibit 28: Top 25 Manufactures 3 Digit SICs by Cost of Materials
1995 *Annual Survey Of Manufactures*

Rank	SIC	Description	Cost of Materials (million dollars)
1	283	Drugs	$2,115
2	357	Computer and office equipment	$1,975
3	308	Miscellaneous plastics products, n.e.c	$1,818
4	366	Communications equipment	$1,595
5	367	Electronic components and accessories	$1,520
6	382	Measuring and controlling devices	$1,104
7	355	Special industry machinery	$937
8	267	Miscellaneous converted paper products	$933
9	384	Medical instruments and supplies	$904
10	381	Search and navigation equipment	$876
11	202	Dairy products	$792
12	209	Miscellaneous food and kindred products	$691
13	372	Aircraft and parts	$644
14	273	Books	$635
15	275	Commercial printing	$632
16	335	Nonferrous rolling and drawing	$608
17	208	Beverages	$600
18	265	Paperboard containers and boxes	$580
19	262	Paper mills	$564
20	386	Photographic equipment and supplies	$476
21	394	Toys and sporting goods	$470
22	233	Women's and misses' outerwear	$445
23	289	Miscellaneous chemical products	$429
24	349	Miscellaneous fabricated metal products	$405
25	339	Miscellaneous primary metal products	$377

Exhibit 29: Top 25 Manufactures 3 Digit SICs by New Capital Expenditures 1995 *Annual Survey Of Manufactures*

Rank	SIC	Description	New Capital Expenditures (million dollars)
1	283	Drugs	$441
2	367	Electronic components and accessories	$206
3	366	Communications equipment	$165
4	308	Miscellaneous plastics products, n.e.c	$138
5	357	Computer and office equipment	$111
6	386	Photographic equipment and supplies	$108
7	384	Medical instruments and supplies	$98
8	382	Measuring and controlling devices	$96
9	275	Commercial printing	$83
10	271	Newspapers	$79
11	342	Cutlery, hand tools, and hardware	$68
12	262	Paper mills	$60
13	355	Special industry machinery	$59
14	339	Miscellaneous primary metal products	$53
15	289	Miscellaneous chemical products	$51
16	267	Miscellaneous converted paper products	$45
17	356	General industrial machinery	$43
18	359	Industrial machinery, n.e.c.	$42
19	346	Metal forgings and stampings	$38
20	372	Aircraft and parts	$37
21	349	Miscellaneous fabricated metal products	$35
22	394	Toys and sporting goods	$33
23	202	Dairy products	$32
24	329	Miscellaneous nonmetallic mineral products	$32
25	381	Search and navigation equipment	$25

Exhibit 30: Top 10 TURA Industries 2 Digit SICs by Average Gross State Product 1998-2005 From Bureau of Economic Analysis *BEA Regional Projections to 2045

Rank	SIC	Description	Gross State Product (millions of $87)
1	50 & 51	Wholesale trade	12,929
2	73 & 76	Business and miscellaneous repair services	8,634
3	35	Industrial machinery and equipment	7,137
4	36	Electronic and other electric equipment	5,555
5	48	Communications	4,919
6	49	Electric, gas, and sanitary services	4,679
7	38	Instruments and related products	3,776
8	27	Printing and publishing	2,048
9	34	Fabricated metal products	2,037
10	37 (except 371)	Other transportation equipment	1,689

* Regional Economic Analysis Division, Bureau of Economic Analysis, United States Department of Commerce. *Data From BEA Regional Projections To 2045: Volume 1, States*. Published July, 1995

Exhibit 31: Top 10 TURA Industries 2 Digit SICs by Average Employment 1998-2005
From Bureau of Economic Analysis *BEA Regional Projections to 2045

Rank	SIC	Description	Employment (thousands of jobs)
1	73 & 76	Business and miscellaneous repair services	305
2	50 & 51	Wholesale trade	188
3	72	Personal services	65
4	35	Industrial machinery and equipment	60
5	38	Instruments and related products	58
6	27	Printing and publishing	56
7	36	Electronic and other electric equipment	45
8	75	Auto repair, services, and parking	33
9	34	Fabricated metal products	33
10	48	Communications	29

Exhibit 32: Top 10 TURA Industries 2 Digit SICs
by Projected Average Annual Growth in Gross State Product (GSP) 1998 -2005
From Bureau of Economic Analysis *BEA Regional Projections to 2045*

Rank	SIC	Description	Projected Average Annual Growth in GSP
1	73 & 76	Business and miscellaneous repair services	2.4%
2	35	Industrial machinery and equipment	2.3%
3	37 (except 371)	Other transportation equipment	2.2%
4	50, 51	Wholesale trade	2.0%
5	29	Petroleum and coal products	1.9%
6	30	Rubber and miscellaneous plastics products	1.4%
7	39	Miscellaneous manufacturing industries	1.3%
8	28	Chemicals and allied products	1.1%
9	38	Instruments and related products	1.0%
10	22	Textile mill products	0.6%

Exhibit 33: Top 10 TURA Industries 2 Digit SICs
by Projected Absolute Growth in Gross State Product (GSP) 2000-2010
From Bureau of Economic Analysis *BEA Regional Projections to 2045*

Rank	SIC	Description	Projected Absolute Growth in GSP (Millions of 1987 $)
1	50, 51	Wholesale trade	$2,654
2	73, 76	Business and miscellaneous repair services	$1,898
3	48	Communications	$1,145
4	35	Industrial machinery and equipment	$1,118
5	49	Electric, gas, and sanitary services	$789
6	38	Instruments and related products	$407
7	45	Transportation by air	$391
8	37 (except 371)	Other transportation equipment	$310
9	30	Rubber and miscellaneous plastics products	$186
10	39	Miscellaneous manufacturing industries	$153

* Regional Economic Analysis Division, Bureau of Economic Analysis, United States Department of Commerce. *Data From BEA Regional Projections To 2045: Volume 1, States*. Published July, 1995

APPENDIX C: SOURCES OF MASSACHUSETTS ECONOMIC INFORMATION ON THE INTERNET

- State of Massachusetts Employment and Wages (ES-202) information for 1993, 1995, and the fourth quarter of 1996. This information is published on the Internet at:
  - http://www.magnet.state.ma.us/det/lmi/es-202/202st93a.txt;
  - http://www.magnet.state.ma.us/det/lmi/es-202/202st95a.txt; and
  - http://www.magnet.state.ma.us/det/lmi/es-202/quart
- The *Economic Census 1992 for State of Massachusetts*, available on the Internet at:
  - http://govinfo.kerr.orst.edu/cgi-bin/econ-state?Massachusetts
- Bureau Of The Census, *Annual Survey Of Manufactures*, Table 2. Statistics for the United States and States by Industry Group: 1995 and 1994, available on the Internet at:
  - http://www.census.gov/prod/2/manmin/asm/m95as3.pdf
- Regional Economic Analysis Division, Bureau of Economic Analysis, United States Department of Commerce. *Data From BEA Regional Projections To 2045: Volume 1, States*. Published July, 1995. Available on the Internet at:
  - http://govinfo.kerr.orst.edu/cgi-bin/proj2045?05-state.mas

APPENDIX D: ADDITIONAL EXHIBITS RANKING MASSACHUSETTS INDUSTRIES BASED ON TURA DATA

Exhibit 34: Summary Environmental Ranking of Massachusetts Industry at 3 Digit SIC Level All TURA Sectors in Order of Use Hazard Rank

				Air Data						Hazard Rank Based On		
3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	CAPs	VOCs	NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	TURA Use	TURA Modified TRI	TURA Generated as Byproduct
282	Plastics materials and synthetics	113	18	25	15		24	12	29	1	8	6
289	Miscellaneous chemical products	63	24	12	26	16	1	9	21	2	22	5
308	Miscellaneous plastics products, n.e.c.	12	33	17	1		18	4	9	3	6	13
516	Chemicals and allied products	41	38	82	70					4	39	46
335	Nonferrous rolling and drawing	37	14	40	25	10		1	27	5	9	10
346	Metal forgings and stampings	82	8	37	38	13	40	26	44	6	5	8
262	Paper mills	91	79	3	23	2	4	10	14	7	3	3
286	Industrial organic chemicals	172	19	36	55	20	6	60	65	8	36	12
491	Electric services	67	56	1	7	4	39			9	1	1
367	Electronic components and accessories	10	1	20	10	19	13	6	3	10	2	2
347	Metal services, n.e.c.	38	2	29	8	12	23	28	36	11	4	4
226	Textile finishing, except wool	74	47	9	13	5	30	43	5	12	10	9
364	Electric lighting and wiring equipment	43	39	45	24		36	36	42	14	12	15
334	Secondary nonferrous metals	174	27	54	75			55	79	15	44	23
284	Soap, cleaners, and toilet goods	116	48	21	28		15	16	40	16	27	21
329	Misc. nonmetallic mineral products	99	52	11	35					17	33	58
285	Paints and allied products	135	37	46	20		21	47	53	18	26	25
281	Industrial inorganic chemicals	104	34	19	52		16	41	50	19	42	33
349	Misc. fabricated metal products	79	5	23	16		38	27	41	20	31	20
229	Miscellaneous textile goods	89	46	24	2		29	40	4	21	7	7
372	Aircraft and parts	92	9	7	31		41	38	18	22	21	11
249	Miscellaneous wood products	122	76	63	45					23	76	79
386	Photographic equipment and supplies	90	4	8	14		8	42	37	24	14	14
496	Steam and air-conditioning supply	187	87	5	65		31			25	35	22
494	Water supply	168		74	74					26	40	62
493	Combination utility services	128	3	6	44		34			27	29	18
495	Sanitary services	40	40	2	9	1	26			28	78	86
342	Cutlery, hand tools, and hardware	64	12	14	33		46	11	25	29	17	28
267	Misc. converted paper products	66	22	22	3			2	1	30	11	16
332	Iron and steel foundries	129	71	34	27		52	30	67	31	58	38
275	Commercial printing	17	25	32	4		22	46	30	32	20	17
384	Medical instruments and supplies	35	30	57	39		43	19	20	33	25	19
339	Miscellaneous primary metal products	108	32	81	76			14	57	34	38	30
202	Dairy products	71	88	31	78		2	21	13	35	46	31
721	Laundry, cleaning, & garment services	29	29	28	21		12			36	18	35
306	Fabricated rubber products, n.e.c.	81	54	16	6	8		29	46	37	19	29
341	Metal cans and shipping containers	178	50	77	18			77	84	38	13	24
331	Blast furnace and basic steel products	134	13	60	54			24	66	39	15	27
396	Costume jewelry and notions	153	45	59	57					40	62	49
394	Toys and sporting goods	78	49	26	17					41	24	41
355	Special industry machinery	24	31	53	40		10	20	32	42	47	26
311	Leather tanning and finishing	164	74	49	12					43	73	70
369	Misc. electrical equipment & supplies	106	43	51	53		9	50	54	45	59	37
358	Refrigeration and service machinery	68		84	60		17	59	59	46	50	32
391	Jewelry, silverware, and plated ware	86	11	38	42		45			47	61	56
382	Measuring and controlling devices	14	17	10	22		35	13	11	48	30	39
208	Beverages	84		35	79		5	45	28	49	80	48
376	Guided missiles, space vehicles, parts	101	15	50	50		50	18	7	50	56	40
326	Pottery and related products	119	36	62	73					51	70	71
283	Drugs	32	35	41	19		32	5	8	52	64	44
517	Petroleum and petroleum products	65	21	33	5	11				53	74	83
371	Motor vehicles and equipment	80	81	67	67		33	71	49	54	69	61
203	Preserved fruits and vegetables	110		30	72	9	3	33	22	56	77	50
348	Ordnance and accessories, n.e.c.	132	6	52	63			35	48	57	48	63
344	Fabricated structural metal products	21	57	58	29		49	15	24	58	49	72

Exhibit 34: Summary Environmental Ranking of Massachusetts Industry at 3 Digit SIC Level
All TURA Sectors in Order of Use Hazard Rank

3 Digit SIC	Description	Summary Economic Rank	RCRA/ BRS Mass	Air Data		NPDES Discharge	MWRA Discharge to POTWs	Energy Use	Water Use	Hazard Rank Based On		
				CAPs	VOCs					TURA Use	TURA Modified TRI	TURA Generated as Byproduct
336	Nonferrous foundries	123	62	70	64		53	22	61	59	71	81
399	Miscellaneous manufactures	51	20	15	34		44			60	23	45
357	Computer and office equipment	54	7	65	32		28	3	10	61	57	36
356	General industrial machinery	31	42	48	41	23	27	34	38	62	45	47
305	Hose & belting & gaskets & packing	120	23	55	58			64	70	63	16	42
176	Roofing and Sheet Metal Work	47		75	83					64	82	68
263	Paperboard mills	163		4	48		11	62	56	65	32	52
209	Misc. food and kindred products	46		13	47		7	17	6	66	41	59
345	Screw machine products, bolts, etc.	73	26	69	59		42	49	55	67	28	53
222	Broadwoven fabric mills, manmade	130		47	37	3		57	16	68	83	80
351	Engines and turbines	157	61	42	69	6		73	75	69	79	84
381	Search and Navigation Equipment	83	73	85	49		25	39	39	70	37	51
302	Rubber and plastics footwear	133		66	80			65	74	71	84	69
265	Paperboard containers and boxes	55	58	27	36		37	8	2	72	53	74
492	Gas production and distribution	88	67	18	30					73	85	54
239	Misc. fabricated textile products	56		79	77		47	48	68	74	54	78
314	Footwear, except rubber	146		64	43					75	86	77
343	Plumbing and heating, except electric	142		73	71		48	70	76	76	87	87
251	Household furniture	94	60	39	11					77	34	55
279	Printing trade services	85		78	61		51	83	77	78	67	57
225	Knitting mills	117		43	51		19	53	15	79	75	60
253	Public building & related furniture	150	41	61	81					80	72	82
252	Office furniture	161	72	72	66					81	66	65
259	Miscellaneous furniture and fixtures	181		80	84					82	43	66
451	Air transportation, scheduled	15		86	86					83	55	67
299	Misc. petroleum and coal products	141	83	76	82			61	35	84	63	73
254	Partitions and fixtures	100		71	68					85	51	75
769	Miscellaneous repair shops	45	68	56	56					86	52	76
228	Yarn and thread mills	131		68	46			78	47	87	60	85

APPENDIX E: INFORMATION ON TURA FILINGS BY ECONOMIC SECTOR

This appendix provides tables that present information on the number and percentage of TURA filers at the 3 and 4 digit SIC level.

Exhibit 35: Top 29 TURA Filers by Number of Filers (3 Digit SICs)
All TURA Filers (all 3 Digit SICs with 10 or more filers)

Rank	SIC	Description	Number of Filers
1	367	Electronic components & accessories	78
2	347	Metal services, n.e.c.	60
3	308	Misc. plastics products, n.e.c.	55
4	289	Miscellaneous chemical products	41
5	349	Misc. fabricated metal products	39
6	335	Nonferrous rolling and drawing	30
7	282	Plastics materials and synthetics	26
8	267	Misc. converted paper products	24
9	284	Soaps, cleaners, and toilet goods	23
10	262	Paper mills	22
11	285	Paints and allied products	22
12	346	Metal forgings and stampings	22
13	491	Electric services	22
14	306	Fabricated rubber products, n.e.c.	21
15	382	Measuring and controlling devices	20
16	229	Miscellaneous textile goods	18
17	721	Laundry, cleaning, garments	17
18	364	Electric lighting & wiring equip.	15
19	226	Textile finishing, except wool	14
20	342	Cutlery, hand tools, and hardware	14
21	384	Medical instruments and supplies	14
22	391	Jewelry, silverware, & plated ware	14
23	331	Blast furnace & basic steel prods	11
24	339	Miscellaneous primary metal prods	11
25	281	Industrial inorganic chemicals	10
26	286	Industrial organic chemicals	10
27	311	Leather tanning and finishing	10
28	355	Special industry machinery	10
29	372	Aircraft and parts	10

Exhibit 36: Top 25 TURA Filers by Number of Filers (4 Digit SICs)
All TURA Filers

Rank	SIC	Description	Number of Filers
1	3471	Plating and Polishing	44
2	3679	Electronic Components, n.e.c.	29
3	3089	Plastics Products, n.e.c.	26
4	3499	Fabricated metal products, nec	26
5	2821	Plastics Materials and Resins	24
6	2621	Paper mills	22
7	2851	Paints and Allied Products	22
8	4911	Electric services	22
9	3672	Printed circuit boards	21
10	2899	Chemical Preparations, n.e.c.	20
11	3069	Fabricated Rubber Products, n.e.c.	18
12	2891	Adhesives and Sealants	17
13	3469	Metal Stampings, n.e.c.	17
14	3357	Nonferrous wire drawing & insulating	16
15	3479	Metal coating & allied services	16
16	2672	Paper, Coated & Laminated: n.e.c.	15
17	3674	Semiconductors & related devices	15
18	3087	Custom compound purchased resins	12
19	3841	Surgical and Medical Instruments	11
20	2295	Coated fabrics, not rubberized	10
21	2842	Polishes and Sanitation Goods	10
22	3081	Unsupported plastics film & sheet	10
23	3111	Leather Tanning and Finishing	10
24	3724	Aircraft Engines and Engine Parts	9
25	5169	Chemicals & allied products, n.e.c.	9

APPENDIX F: INFORMATION ON TOXICS USE REDUCTION SCIENCE ADVISORY BOARD CHEMICAL RANKINGS

For the past three years, the Toxics Use Reduction Science Advisory Board has assisted the Toxics Use Reduction Institute in preparing recommendations concerning petitions to delist chemicals on the TURA Toxic and Hazardous Substance List. Throughout this process the Board has struggled with decisions concerning chemicals that are "less hazardous than others on the list." Therefore, the Board decided to categorize the list. This categorized list will provide guidance to companies and technical assistance providers making chemical substitution decisions.

Many models for chemical prioritization were reviewed by the Board. The majority of these models do not consider safety issues which are of particular concern to the Board. The Board chose the following eight criteria to be considered in categorizing the list of chemicals: oral LD50, reference dose (RfD), carcinogen (IARC Classification), threshold limit value (TLV), aquatic LC50, bioconcentration factor (BCF), flashpoint, and pH. The available data were collected by the Tellus Institute on the 250 chemicals that have been reported under the Toxics Use Reduction Act since 1990.

Instead of developing an algorithm that may be difficult to understand or could ignore unforeseen risks, the Board used the Delphi Method, a "committee" approach to decision making. This approach was used by Polaroid in developing their chemical ranking system, and it allows for incorporation of the Board members' professional experiences which is especially important for chemicals that have little or no data available. Each Board member chose their "most hazardous 50 chemicals" and "least hazardous 50 chemicals" based on their own set of criteria and personal experience. Each chemical on both lists is currently being discussed in detail to create a two lists: more hazardous chemicals and less hazardous chemicals. As of April 1998 a draft list of more hazardous chemicals has been completed with further revisions to be made in May 1998 when the Board will present their work to the Toxics Use Reduction Administrative Council.